

Sanitary Landfill Operations In New York State

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SANITARY LANDFILLS are becoming more popular as a satisfactory method of refuse disposal. Generally they can be operated inexpensively in many different types of terrain. The term "sanitary landfill" denotes an operation in which refuse is deposited in or on the ground in an orderly manner, compacted, covered daily with 6 inches of earth, and again compacted. A modified landfill, however, is not necessarily covered daily or with 6 inches of earth. The term "sanitary landfill" used in the remainder of this paper includes all the landfills investigated, although some are actually modified landfills, and these are identified in the table on p. 546.

A survey made by the New York State Health Department in 1959 indicated that only 85 communities in the State, excluding New York City, operated sanitary landfills or incinerators. Since there are some 1,546 towns, villages, and cities in the upstate area, it was obvious that much of the 5 million tons of refuse produced each year was being disposed of at open dumps. The growing number of complaints led this department to develop regulations controlling refuse disposal areas.

On January 1, 1963, part 19 of the New York State Sanitary Code on refuse disposal became effective in the State. In general, part 19 requires that refuse disposal areas shall be operated as sanitary landfills unless special exemption is granted by the full-time health officer. Specific regulations apply to compacting of refuse and covering with 6 inches of

earth daily, control of dumping so refuse is confined to an effective working area, prevention of water pollution, insect and rodent control, fencing to confine refuse to the site, salvaging, and maintenance of approach roads to disposal areas.

The Bureau of General Engineering and Sanitation Services, New York State Department of Health, inspected 24 sanitary landfills operated in the State in 1962 to give municipal officials background on existing operations. This report is based on data obtained during the inspection. Cost information derived from the study should be used with caution, since expenses vary according to the population served and may apply to only a few landfills.

Costs and Methods of Operation

The investigation indicated that the per capita cost of operating a sanitary landfill tended to decrease with increasing populations. This is not necessarily true for all sanitary landfills because many variables are involved in determining the cost of an operation. These variables include the price and availability of land, labor, and machinery as well as the number of hours the site is open.

For example, a city with a population of 100,000 may have a suitable site on city-owned property. Another city of similar population size may have to rent or purchase land to operate a sanitary landfill satisfactorily. In comparing costs of operating existing sanitary landfills, all the variables must be considered before attempting to assign these costs to another municipality of comparable size. The range of costs experienced by similarly sized

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communities is illustrated in table 1, which is based on information concerning sanitary landfills in 17 municipalities of the State. Cost information was not available for four landfills; the size of the population group served by two others was not known; and the remaining one, serving a population of 250,000, had a mean annual per capita cost of \$0.60.

Inefficient operations result in high costs. Two cities operated landfills for rubbish only and disposed of garbage at additional cost. If these operations were combined, costs could be reduced. One city taxed residents for the landfill operation but allowed anyone to dump. Other operations were costly because of poor site locations. Although many factors are involved in the selection of a site, distance from population centers and type of soil are the major factors that govern operational costs.

Heavy clay soils should be avoided in selecting a site because operations are severely hampered by mud during inclement weather. Trucks bog down and cover material must be hauled in, wasting time and money. The alternative is to stockpile suitable fill material to stabilize access roads during foul weather.

The area method was used exclusively in half of the landfill operations observed. Another 16 percent combined the area method with trenching or ramping or both, with trenching being used in winter (table 2). The method used depends on area, topography, proximity to ground water, desired final grade, and available equipment.

Local characteristics may outweigh these points in choosing a particular method. One city considered trenching ideal and had a dragline and a bulldozer. However, the soil at the site was fine, windblown sand that would not support itself in the sidewalls of a trench.

Equipment

Because of its versatility, the crawler-tractor with a front-end loader was the most widely used type of equipment (table 2). A front-end loader was used in some landfill operations where it was not required, but it was also used for snow removal. At other sites front-end loaders were used exclusively in trenching where the value of the bucket is wasted. Once

Table 1. Annual operating costs of sanitary landfills

Population served	Number of landfills	Yearly per capita cost	
		Range	Mean
Less than 10,000-----	5	\$0. 80-\$2. 54	\$1. 49
10,000-25,000-----	5	. 55- 1. 14	. 81
25,000-50,000-----	4	. 52- . 90	. 66
50,000-100,000-----	3	. 24- . 75	. 45

trenches are developed, only a bulldozer is necessary to carry out the operation. Normally, draglines or shovels are used to dig trenches, although a bulldozer can be used in smaller operations.

The main difficulty encountered with equipment was starting it in cold weather. As a result, almost all landfills had heated garages. (A small village which did not keep its equipment in a garage used six batteries the first winter.) One operator commented that he had trouble with his crawler-tractor during the winter because the snow and ice jammed the sprockets, although no other operators had similar difficulties.

Repair costs were high for all crawler-type machines. Those operated 4 to 8 hours a day averaged \$1,500 to \$2,000 for repairs annually. Replacement of treads was expected after 2 or 3 years. Most operators felt that active use of the machines in abrasive granular soil caused damage to rollers and tread-pin connections.

Because of high repair costs, one operation switched to a rubber-tired tractor, and repair costs dropped. However, in operating an area-method landfill, the driver does not compact refuse until it is covered to avoid tire damage on hard, sharp objects in the refuse. As a result, compaction is poor so that considerable final settlement takes place.

Cover Material

A half sand, half clay-silt soil is ideal cover material for landfill operations. Only a few sites have this type of soil, however, and all types of soil are used (table 2).

Two landfills were being operated at old dumpsites where refuse was once burned. One

landfill successfully uses this burned refuse for cover material. Stockpiled cover material should be covered with vegetation, straw, leaves, and similar material to keep it relatively dry.

At a site where an area-method fill was being operated, the equipment operator stockpiled fill for the winter but left it uncovered. He did this only once; the soil exposed to the weather had been broken up so that it absorbed a great deal of moisture and froze during the winter. He found that it was easier to excavate from a natural bank than to try and move the frozen stockpiled soil.

Working Hours

Landfills serving populations of more than 10,000 should be kept open at least 45 hours per week. Landfills serving smaller populations were operated an average of 32 hours per week. Regardless of the population served, many sites stay open to accommodate residents disposing of their own refuse. Following is a tabulation of the weekly working hours for 22 landfills by size of population served.

<i>Population served</i>	<i>Number of landfills</i>	<i>Range of hours</i>	<i>Mean hours</i>
Less than 10,000.....	7	8-54	32
10,000-25,000.....	6	45-60	52
25,000-50,000.....	4	48-64	55
50,000-100,000.....	3	45-48	47
100,000.....	1	-----	56
250,000.....	1	-----	48

A sanitary landfill cannot be properly operated unless people are kept out after closing hours. Many fires are set by people who dump when no operator or watchman is in attendance. One way to control promiscuous dumping is to have the local police patrol the area and fine violators. This procedure has been effective because levying only one or two fines in an area usually prevents further dumping.

Burning

Burning was practiced at more than half the landfills (table 2). At three sites all refuse was burned before it was buried. Two of these sites were in isolated areas. The other was approx-

imately a quarter-mile from the city of Poughkeepsie and was the subject of complaints.

Burning is actually unnecessary at any of these sites and results in air pollution. Burning reduces the volume, but it also causes a nuisance. Volume reduction is more satisfactorily accomplished by good compaction without burning.

Scavenger Wastes and Salvaging

Scavenger wastes were accepted at only 17 percent of the landfills (table 2). At these sites septic tank wastes were placed in open pits, remote from the working landfill area, and allowed to dry before being covered. Esthetic considerations caused many sites to reject scavengers. In order to control odors emitted, these wastes must be placed in pits and covered daily with approximately 6 inches of earth.

Salvaging was practiced at 46 percent of the landfill sites in the State (table 2). Equipment operators felt that "pickers" interfered with operations. Where only one man is allowed to "pick," usually the custodian or watchman, it does not seem to create problems.

More than half of the landfills served only private haulers. This number is high because the towns that have landfills are all served by private haulers. Many sites serve both municipal forces and private haulers, and private haulers used 83 percent of the sites. Following is a breakdown of users of 24 landfills.

<i>Refuse deliverers</i>	<i>Number</i>	<i>Percent</i>
Private haulers only.....	13	52
Municipal forces and private haulers..	7	31
Municipal forces only.....	4	17
Contract haulers only.....	0	0

Warsaw village, with a population of less than 4,000, was unique in the use of labor for its collection and disposal operations. The same men do both jobs. This is an excellent way for small municipalities to solve their disposal labor problem.

Operating Problems

Fires were reported to be the most difficult operational problem at 10 sanitary landfills. Many sites have no fire-fighting apparatus

Table 2. Summary of sanitary landfills in New York State in 1962

Communities served	Estimated population served (thousands)	Type of refuse	Equipment used	Type of operation	Men employed at site	Type of earth cover	Frequency of coverage	Cover depth (inches)	Depth of each layer (feet)	Depth of total fill (feet)
Auburn ¹	35	Rubbish..	1 payloader, 1 bulldozer...	Ramp.....	4	Sand, gravel.	Daily.....	2-4	7	15
Clarkstown, Orangetown, Nyack, Upper Nyack, South Nyack. ¹	76.4	Mixed....	3 CY crawler payloader...	Area.....	1	Sand.....	do.....	4	5-10	10
Fallsburg.....	(²)	do.....	Crawler payloader.....	Trench.....	1	Sand, gravel.	Daily during summer	6	4	4
Glens Falls.....	18.8	Rubbish..	do.....	Ramp.....	2	Burned refuse, sand.	Daily.....	6	(³)	(³)
Glenville, Scotia.....	26	Mixed....	Rubber-tired payloader...	Area.....	2	Sand.....	do.....	6	20	20
Horseheads town, Horseheads village, Elmira Heights	20	do.....	Bulldozer.....	do.....	1	Gravel.....	do.....	(³)	2	(³)
Lancaster, Tonawanda, Grand Island, Amherst, Clarence, Newstead, Alden	100	do.....	do.....	Area, ramp.	3	do.....	do.....	6	5	60
Middletown, Margaretville	2.9	do.....	do.....	Trench.....	1	Clay, boulders.	do.....	6	2	12
Monticello, Thompson	(²)	do.....	do.....	do.....	1-2	Clay, gravel.	do.....	6	3	15
Newark.....	10	do.....	1½ CY crawler payloader.	Area.....	1	Burned refuse.	do.....	6	(³)	20
Niskayuna.....	14	do.....	1 crawler payloader, highway trucks.	do.....	1-2	Clay, sand.	do.....	6	(³)	(³)
Oneida, Oneida Castle....	11.6	do.....	1 dragline, 1 crawler payloader 1 CY.	Trench.....	2-3	Clay to gravel.	do.....	6	3	15
Oneonta city, Oneonta town.	18	do.....	Crawler, front-end loader, 1¾ CY.	Area.....	1	Sand to boulders.	do.....	6	5	60
Port Jervis, Matamoras, Pa., Milford, Pa. ¹	15	do.....	Crawler payloader, 1½ CY.	Area, trench, ramp.	1	Sand.....	do.....	4	3-5	20
Poughkeepsie ¹	32	do.....	Bulldozer.....	Area.....	3-5	Mixed.....	Weekly.....	2-4	10	10
Rome.....	51	do.....	1 dragline, 1 payloader, 3 CY.	Area, trench.	1	Blown sand.	Daily.....	6	10	20
Rotterdam.....	28	do.....	Crawler payloader.....	Area.....	2	Sand.....	do.....	6	4	20
Salamanca ¹	8.5	do.....	do.....	Area, trench.	1	Clay to sand.	do.....	2	10	10
Schaghticoke town, Schaghticoke village. ¹	6	do.....	Rubber-tired payloader...	Area.....	1	Sand, gravel.	Bi-weekly.	6	5-10	10
Sidney.....	5.5	do.....	1 bulldozer, 1½ CY crawler payloader.	do.....	1-5	Clay to gravel.	Daily.....	6	4	40
Spencerport.....	3	do.....	Crawler payloader.....	Trench.....	1	Sand.....	do.....	6-8	(³)	(³)
Utica.....	105	Garbage..	2 bulldozers, 2 trucks, 1 shovel.	Area.....	4	Mixed.....	do.....	6	(³)	(³)
Warsaw.....	3.7	Mixed....	Crawler payloader.....	Ramp.....	3	Clay to sand.	do.....	6	5	5
Westchester County.....	250	do.....	2 bulldozers, 1 dragline, 12 trucks.	Area.....	16-17	Sand.....	do.....	6	15	15

¹ Modified landfill. ² Large summer populations. Difficult to estimate. ³ Information not available.

other than their disposal equipment to bury fires. This can be costly and dangerous. In Salamanca, the city's bulldozer was severely damaged while attempting to douse a fire; repairs amounted to \$4,000.

Fires plague operations which allow unsupervised dumping. Smoking on sites is a hazard.

"No smoking" signs are being used more widely.

Blowing papers were the subject of complaints at six landfills. Papers can and should be controlled by fencing, but this method is rarely used.

Complaints about odor emissions were reported from six landfills. All complaints re-

Table 2. Summary of sanitary landfills in New York State in 1962—Continued

Communities served	Type of terrain	Burning practiced	Scavenger wastes permitted	Salvaging permitted	Fire fighting water system	Operator	Yearly charges to refuse collectors	Annual cost of operation (thousands)
Auburn ¹	Rolling hills	Yes	No	No	Piped water	City	None	\$31
Clarkstown, Orangetown, Nyack, Upper Nyack, South Nyack. ¹	Swamp	No	Yes	No	Fire pumper	Town	\$100 per month per truck or \$3-\$5 per load.	23
Fallsburg	Foothill	No	No	Yes	None	do	None	8.5
Glens Falls	Flat plain	No	No	No	do	City	\$5 per vehicle	(³)
Glenville, Scotia	Terrace	Yes	Yes	No	Piped water	Town	\$100	20
Horseheads town, Horseheads village, Elmira Heights.	Flood plain	Yes	(²)	Yes	None	do	None	11
Lancaster, Tonowonda, Grand Island, Amherst, Clarence, Newstead, Alden.	Quarry	No	No	No	Pumps	Private	\$2.50-\$3.50 per load.	75
Middletown, Margaretville.	Hillside	Yes	No	Yes	None	Town	None	5.3
Monticello, Thompson	Flat plains	Yes	No	No	do	Village	\$100-\$1,800	9.7
Newark	do	Yes	No	Yes	Piped water	do	None	8
Niskayuna	Rolling hills	No	No	Yes	do	Town	do	16
Oneida, Oneida Castle	do	No	No	No	None	City	\$150	8.8
Oneonta city, Oneonta town.	Ravine	Yes	No	No	Piped water	Contractor	None	13.5
Port Jervis, Matamoras, Pa., Milford, Pa. ¹	Flood plain	Yes	No	Yes	do	City	do	12.5
Poughkeepsie ¹	Swamp	Yes	No	No	Pumps and hose	Town	do	16.5
Rome	Sand dunes	Yes	No	Yes	None	City	do	12
Rotterdam	Ravine	No	No	Yes	Piped water	Town	\$75	18
Salamanca ¹	Flood plain	No	No	Yes	None	City	\$100	7
Schaghticoke town, Schaghticoke village. ¹	Gravel pit	Yes	No	No	do	Town	None	(³)
Sidney	Swamp	No	Yes	Yes	Piped water	Village	\$10	(³)
Spencerport	Foothill	Yes	No	No	None	do	None	4.4
Utica	Flood plain	No	Yes	Yes	Tank truck	Private	do	(³)
Warsaw	Plain	Yes	No	No	None	Village	do	9.5
Westchester County	Tidal flats	No	No	No	Pumps, hose	County	\$2.25 per ton	151

sulted from violations of recommended operating practices. Odors, however, were not a problem where burning was not practiced and where the refuse was covered daily.

Rodents were troublesome at four landfills. Rodents may be reduced by operating equipment regularly to get good compaction of the refuse and cover material.

Flies, dust, and traffic were each found to be minor problems at two sites. Traffic was a headache at landfills serving more than 25,000 people with only one man to control the operation. When the operator is operating the equipment, a car or truck can pull in, dump, and leave without being noticed. This problem occurs at sites that have no restrictions on use.

Distance to Nearest Dwelling

Half the landfills were between 1,000 feet and one-half mile from the nearest dwelling, and 34 percent were less than 1,000 feet from the nearest dwelling.

No one likes living near the "town dump." Opposition occurred when operations started at some sites, but few people object to living near properly operated sanitary landfills.

The number and percent of landfills at various distances from the nearest dwelling follow.

<i>Distance (feet)</i>	<i>Number</i>	<i>Percent</i>
0-250-----	2	8
250-500-----	3	13
500-1,000-----	3	13
1,000-2,640-----	12	50
More than 2,640-----	4	16

Future Land Use

Two-thirds of the landfill areas are not planned for other uses when landfill operations end. Recreational areas have been planned for 5, or 21 percent. Although heavy structures normally are not recommended for construction on landfills because of differential settlement and the emission of noxious, inflammable gases, one village plans to erect a sewage treatment plant on the completed landfill site, and one completed fill was rented for parking heavy trucks and trailers.

Financing Landfills

Forty-six percent (11) of the landfills are supported by general tax funds. Dumping fees contribute to the support of 3, or 12.5 percent. Nine, or 37.5 percent, are supported by both. Only one landfill is supported by collection fees. Dumping fees, ranging from \$1 to \$2.25 per ton, are charged at a few landfills.

The town-operated landfill in Clarkstown realized a profit of about \$5,000 per year even though fill was hauled a distance of 12 miles. The town charged a monthly rate to regular collectors and daily rates to occasional users. The landfill serves five surrounding municipalities. Total income from dumping fees in 1961 was \$28,000, and the cost of operation was approximately \$23,000. Dumping fees were reflected in collection fees, which averaged about \$2.50 per month per residence. Fees for collection

normally average from \$1.60 to \$2 per month per residence.

The Croton Point landfill charged users by the ton and weighed every vehicle entering the site. This is a large county operation with a budget of about \$150,000 per year.

The city of Port Jervis operated a landfill and allowed two Pennsylvania border villages to use the sites at a fee of \$0.25 per cubic yard.

Summary

The Bureau of General Engineering and Sanitation Services, New York State Department of Health, in 1962 collected information on a total of 24 landfills, serving populations ranging from about 3,000 to 250,000. Cost data on 17 showed that per capita operating costs tended to decrease as the size of the population served increased, with a range among 17 landfills of \$0.45 to \$1.49 per year.

The crawler-tractor with a front-end loader was the most widely used type of equipment. Operating crawler-type tractors cost between \$1,500 to \$2,000 annually, with tread replacement expected after 2 or 3 years. It was necessary to house equipment in heated garages to insure that machines would start during cold weather.

The operating hours varied from 8 to 64 hours per week; many sites stayed open extra hours to accommodate residents disposing of their own refuse. Burning refuse at sites was found to be unnecessary and sometimes led to complaints because of odors. Accidental fires were controlled in some areas by posting no smoking signs.

Some small communities successfully met economic problems by combining forces with other municipalities or by operating a sanitary landfill part time, with employees being used for other municipal activities.

The investigation indicated that sanitary landfills can be and are operated under varying conditions. For most, the terrain and soil conditions determined whether the ramp, trench, or area method was used or, a combination of two or three methods, according to the season of the year. The type of operation dictated the type of equipment used, although in some instances the method of operation was determined by the available equipment.